Question 1

Students' achievement on math depends a number of factors. One interesting question to ask is does school play an important role.

In this analysis, I treat math achievement as the response variable. I treat school as a random effect, sex, social economic status, mean social economic status and minority status as fixed effects. I included both SES and MEANSES as fixed effects since both within social economic status and the mean level of social economic status has an effect of student's performance on math.

As shown in Figure 1, the within school variation is $35.88(\tau^2)$. The between school level variation is $2.43(\sigma^2)$. Within school variation is the largest effect. Between school variation is roughly in the same scale as effect of sex or minority status or social economic status.

In conclusion, in term of students' achievement on math, there are no substantial differences between schools. In fact, differences within schools appears to be the largest factor.

Table 1: Figure 1: Summary of Linear Mixed Model for MathAchieve data

	MLE	Std.Error	DF	t-value	p-value
(Intercept)	12.83	0.17	7022	74.73	0
MinorityYes	-2.73	0.20	7022	-13.42	0
SexMale	1.22	0.16	7022	7.57	0
MEANSES	2.88	0.37	158	7.84	0
SES	1.93	0.11	7022	17.76	0
σ	1.56	NA	NA	NA	NA
τ	5.99	NA	NA	NA	NA

Q2

Substance abuse is a serious problem in today's American society. One may suspect effect of treatment depends on the substance the individual is addicted to, with "hard" drugs being more difficult to treat. Also, some effect of treatment may vary among different states. This report will investigates whether these assumptions hold.

I fit a INLA model with type of substance and town as random variable. As for prior, to be safe I choose it to be pc.prec since i did not see clear patterns that suggest otherwise. As for the parameter, I chose it based on variation of the base model without random effects.

From Figure 2, heroin, cocaine and other hard drugs are indeed associated with lower rate of treatment completion, compared with alcohol. Also it's worth-noting the eldest person in the data set is 25 years old. From Figure 3, for the majority of states, 95% confidence interval of its slope contains zero. Change in state results in little change in rate of treatment completion.

In conclusion, harder drugs are more difficult to treat. There's no significant difference in effectiveness of treatment program among different American states.

Table 2: Figure 2: Summary of Substances

Name	mean	0.025quant	0.975quant
(Intercept)	0.7	0.5	0.8
ALCOHOL	1.6	1.6	1.7
HEROIN	0.9	0.9	0.9
OTHER OPIATES AND SYNTHET	0.9	0.9	1.0
METHAMPHETAMINE	1.0	0.9	1.0
COCAINE/CRACK	0.9	0.8	0.9
FEMALE	0.9	0.9	0.9
Hispanic	0.8	0.8	0.8
BLACK OR AFRICAN AMERICAN	0.7	0.7	0.7
AMERICAN INDIAN (OTHER TH	0.7	0.7	0.8
OTHER SINGLE RACE	0.9	0.8	0.9
TWO OR MORE RACES	0.9	0.8	0.9
ASIAN	1.1	1.0	1.2
NATIVE HAWAIIAN OR OTHER	0.8	0.8	1.0
ASIAN OR PACIFIC ISLANDER	1.5	1.2	1.7
ALASKA NATIVE (ALEUT, ESK	0.8	0.6	1.1
HOMELESS	1.0	1.0	1.0
SD for STFIPS	0.7	0.6	0.9
SD for TOWN	0.5	0.5	0.6

Table 3: Figure 3: Summary of States

State	mean	0.025q	0.975q	State	mean	0.025q	0.975q
ALABAMA	0.2	-0.3	0.8	MONTANA	-0.2	-1.0	0.6
ALASKA	0.0	-0.9	0.8	NEBRASKA	0.8	0.4	1.2
ARIZONA	0.0	-1.4	1.4	NEVADA	-0.1	-0.8	0.5
ARKANSAS	-0.1	-0.7	0.5	NEW HAMPSHIRE	0.2	-0.3	0.7
CALIFORNIA	-0.3	-0.6	0.0	NEW JERSEY	0.5	0.2	0.8
COLORADO	0.5	0.1	1.0	NEW MEXICO	-1.2	-2.0	-0.5
CONNECTICUT	0.1	-0.4	0.7	NEW YORK	-0.3	-0.6	0.0
DELAWARE	1.0	0.7	1.3	NORTH CAROLINA	-0.8	-1.1	-0.5
WASHINGTON DC	-0.3	-0.6	0.1	NORTH DAKOTA	-0.3	-1.0	0.4
FLORIDA	1.0	0.7	1.4	OHIO	-0.2	-0.6	0.1
GEORGIA	-0.2	-0.9	0.4	OKLAHOMA	0.6	0.0	1.1
HAWAII	0.2	-0.6	1.1	OREGON	0.1	-0.3	0.5
IDAHO	-0.2	-1.0	0.6	PENNSYLVANIA	0.0	-1.4	1.4
ILLINOIS	-0.5	-0.8	-0.2	RHODE ISLAND	-0.2	-0.6	0.3
INDIANA	-0.1	-0.9	0.8	SOUTH CAROLINA	0.4	0.0	0.7
IOWA	0.4	0.1	0.7	SOUTH DAKOTA	0.5	-0.3	1.3
KANSAS	-0.2	-0.6	0.1	TENNESSEE	0.3	-0.2	0.7
KENTUCKY	-0.2	-0.5	0.2	TEXAS	0.6	0.3	0.9
LOUISIANA	-0.6	-1.0	-0.1	UTAH	0.1	-0.5	0.7
MAINE	0.1	-0.7	1.0	VERMONT	-0.2	-1.1	0.6
MARYLAND	0.5	0.2	0.8	VIRGINIA	-2.9	-3.3	-2.6
MASSACHUSETTS	0.8	0.4	1.3	WASHINGTON	-0.1	-0.5	0.3
MICHIGAN	-0.4	-0.7	0.0	WEST VIRGINIA	0.0	-1.4	1.4
MINNESOTA	0.4	0.0	0.9	WISCONSIN	0.0	-1.4	1.4
MISSISSIPPI	0.0	-1.4	1.4	WYOMING	0.0	-1.4	1.4
MISSOURI	-0.4	-0.7	-0.1	PUERTO RICO	0.6	-0.1	1.3